

COPPER ALLOY EXCELLENT IN ELECTRIC -DISCHARGE WEAR RESISTANCE

Patent Number: JP9263864
 Publication date: 1997-10-07
 Inventor(s): OGURA TETSUZO
 Applicant(s): KOBE STEEL LTD
 Requested Patent: ☐ JP9263864
 Application Number: JP19960097785 19960326
 Priority Number(s):
 IPC Classification: C22C9/10; H01R39/04; H01R39/20
 EC Classification:
 Equivalents:

Abstract

PROBLEM TO BE SOLVED: To obtain a copper alloy excellent in electric-discharge wear resistance, used for parts causing electric-discharge wear, such as motor commutator and various contacts.
SOLUTION: This copper alloy has a composition consisting of, by weight, 0.1-1.0% Si and the balance copper with inevitable impurities and further containing, if necessary, 0.01-6.0%, in total, of at least one or more kinds among 0.01-1.0% Mg, 0.01-1.0% Al, 0.01-1.0% Ti, 0.01-1.5% Cr, 0.01-1.0% Mn, 0.01-3.0% Fe, 0.01-3.0% Co, 0.01-4.0% Ni, 0.01-5.0% Zn, 0.01-1.0% Zr, 0.01-1.0% Ag, and 0.01-2.0% Sn.

Data supplied from the esp@cenet database - I2

TOP

(19) 日本国特許庁 (J P)

(12) 公開特許公報 (A)

(11) 特許出願公開番号

特開平9-263864

(43) 公開日 平成9年(1997)10月7日

(51) Int.Cl. ⁸	識別記号	庁内整理番号	F I	技術表示箇所
C 2 2 C 9/10			C 2 2 C 9/10	
H 0 1 R 39/04			H 0 1 R 39/04	
			39/20	
// H 0 2 K 13/00			H 0 2 K 13/00	D

審査請求 未請求 請求項の数 2 F D (全 4 頁)

(21) 出願番号 特願平8-97785

(22) 出願日 平成8年(1996)3月26日

(71) 出願人 000001199

株式会社神戸製鋼所

兵庫県神戸市中央区脇浜町1丁目3番18号

(72) 発明者 小倉 哲造

山口県下関市長府港町14番1号 株式会社

神戸製鋼所長府製造所内

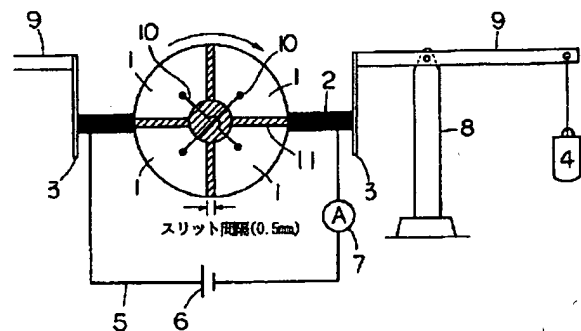
(74) 代理人 弁理士 香本 薫

(54) 【発明の名称】 耐放電摩耗性が優れる銅合金

(57) 【要約】

【課題】 耐放電摩耗性に優れた銅合金を得る。

【解決手段】 Si:0.1~1.0wt%を含有し、さらに必要に応じてMg:0.01~1.0wt%、Al:0.01~1.0wt%、Ti:0.01~1.0wt%、Cr:0.01~1.5wt%、Mn:0.01~1.0wt%、Fe:0.01~3.0wt%、Co:0.01~3.0wt%、Ni:0.01~4.0wt%、Zn:0.01~5.0wt%、Zr:0.01~1.0wt%、Ag:0.01~1.0wt%、Sn:0.01~2.0wt%のうち少なくとも1種類以上を総量で0.01~6.0wt%含有し、残部が銅及び不可避免不純物からなる銅合金。



【特許請求の範囲】

【請求項1】 Si:0.1~1.0wt%を含み、残部が銅及び不可避不純物からなることを特徴とする耐放電摩耗性が優れる銅合金。

【請求項2】 Si:0.1~1.0wt%を含有し、さらにMg:0.01~1.0wt%、Al:0.01~1.0wt%、Ti:0.01~1.0wt%、Cr:0.01~1.5wt%、Mn:0.01~1.0wt%、Fe:0.01~3.0wt%、Co:0.01~3.0wt%、Ni:0.01~4.0wt%、Zn:0.01~5.0wt%、Zr:0.01~1.0wt%、Ag:0.01~1.0wt%、Sn:0.01~2.0wt%のうち少なくとも1種類以上を総量で0.01~6.0wt%含有し、残部が銅及び不可避不純物からなることを特徴とする耐放電摩耗性が優れる銅合金。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、モーターコンミュテータ（整流子）又は各種接点など放電摩耗の起こる部品に使用される銅合金に関するものである。

【0002】

【従来の技術】従来、モーターコンミュテータ又は接点用材料として、導電率の高い無酸素銅、タフピッチ銅、りん脱酸銅、銀入り銅などが用いられている。これは、導電率の高い材料は接点でのジュール熱の発生が少なく、放熱効果も高いため、接点の高温化が抑制でき、放電量が少なくなることによる。しかし、自動車などに用いられるコンミュテータや各種接点部品は、信頼性向上の要求から、さらなる高寿命が求められている。そのため、上記純銅系材料に代わる耐放電摩耗性が優れる銅合金の開発が必要となってきた。

【0003】

【発明が解決しようとする課題】本発明は上記従来技術の問題点に鑑みてなされたものであり、耐放電摩耗性が優れる銅合金を提供することを目的とする。

【0004】

【課題を解決するための手段】本発明に関わる耐放電摩耗性が優れる銅合金は、Si:0.1~1.0wt%を含み、残部が銅及び不可避不純物からなることと特徴とし、さらに必要に応じてMg:0.01~1.0wt%、Al:0.01~1.0wt%、Ti:0.01~1.0wt%、Cr:0.01~1.5wt%、Mn:0.01~1.0wt%、Fe:0.01~3.0wt%、Co:0.01~3.0wt%、Ni:0.01~4.0wt%、Zn:0.01~5.0wt%、Zr:0.01~1.0wt%、Ag:0.01~1.0wt%、Sn:0.01~2.0wt%のうち少なくとも1種類以上を総量で0.01~6.0wt%含有する。

【0005】以下、本発明に係る銅合金の各成分の添加

理由及び組成限定理由について説明する。

Si:0.1~1.0wt%

Siは、本発明合金において必須の成分である。Siの酸化物(SiO₂)は生成自由エネルギーが小さく、かつ融点が高い(1720℃)のため、高温で安定であり、さらに、高温での電気抵抗が高い(1200℃で3×10²Ω・m)。一方、放電は通電によって発熱した接点がOFFになる過程で、材料表面からの電子放射と金属蒸気との相互作用で起こるものと考えられる。Siを含有する合金は、この過程において、材料表面に酸化膜を生成しやすい。しかもこの酸化膜は高温で安定でかつ電気抵抗が高いため、放電をすみやかに消滅させる役割を担うものである。本発明者はコンミュテータや各種接点部品等、放電摩耗の起こる部品には、導電率以外にこの効果が重要であることを見出し、本発明をなし得たものである。そして、Si含有量が0.1wt%未満ではこの効果は小さく、1.0wt%を超えて含有しても、この効果が飽和するとともに導電率の低下、熱間加工性の劣化を招く。したがって、Si含有量は0.1~1.0wt%とする。特に好ましい範囲は0.2~0.8wt%である。

【0006】Mg、Al、Mn、Ag:各々0.01~1.0wt%、Zn:0.01~5.0wt%、Sn:0.01~2.0wt%

これらの元素はCu-Si合金をさらに固溶強化する目的で添加されるものである。接点材で最も重要な特性は耐放電摩耗性であるが、接点ON-OFFの繰り返しによる機械摩耗量が小さいことも要求される。したがって、耐摩耗性を向上させるために適宜添加されるものである。各々の含有量が0.01wt%未満ではこの効果は小さい。また、各々の元素の上限値を超えて含有しても効果が飽和するとともに、Agを除いて導電率の低下が著しくなる。なお、Agは高価であり、経済的制約も考慮して上記の上限値を設定した。各々の好ましい含有量は、Mg、Al、Mn、Agが各々0.01~0.6wt%、Znが0.03~3.5wt%、Snが0.1~1.5wt%である。

【0007】Ti、Zr:各々0.01~1.0wt%
Cr:0.01~1.5wt%
Fe、Co:各々0.01~3.0wt%
Ni:0.01~4.0wt%

これらの元素は、Cu-Si合金に添加されることによって、Siと化合物を形成し析出強化する。先に挙げた元素と同様に耐摩耗性を向上させる目的で適宜添加されるものである。各々の含有量が0.01wt%未満では、この効果は小さい。また、各々の元素の上限を超えて含有しても効果が飽和するとともに導電率の低下が著しくなる。したがって、上記の上下限値を設定した。各々の好ましい含有量は、Tiが0.05~1.0wt%、Zrが0.01~0.3wt%、Crが0.05~

1. 0wt%、Fe、Coが各々0.1~2.5wt%、Niが0.3~4wt%である。

【0008】なお、上記副成分は2種以上複合添加することができるが、その総量が0.01wt%未満では、強度向上の効果は小さく、6.0wt%を超えて含有すると導電率の低下が著しくなる。したがって、複合添加する場合の総量は0.01~6.0wt%とした。好ましくは0.5~3%である。好ましい副成分の組み合わせとしては、Ti（又はZr、Cr、Fe、Co、Ni）とMg（又はAl、Mn、Ag、Zn、Sn）の組み合わせが挙げられる。

【0009】

【実施例】以下、本発明の実施例についてその比較例と

比較して説明する。クリプトル炉を用いて、表1に示す組成の銅合金を、大気中で木炭被覆下にて溶解及び鑄造し、厚さ50mm、幅75mm、長さ180mmの鑄塊を得た。この鑄塊の表面と裏面を切削した後、950℃の温度で厚さ15mmまで熱間圧延した。次に、グラインダーにより酸化スケールを除去した後、冷間圧延及び500℃の温度で4時間の焼鈍を行った後、最後の冷間圧延で4.0mmの厚さとした。表1に本発明に係る銅合金及び比較合金のビッカース硬さと導電率を併記する。

【0010】

【表1】

		化学成分(wt%)			導電率 (%IACS)	ビッカース硬さ (Hv)	摩耗量 (mg)
		Cu	Si	副成分			
本 発 明 合 金	1	残部	0.19	—	57	106	430
	2	"	0.52	—	32	117	360
	3	"	0.91	—	22	129	460
	4	"	0.48	Mg 0.34	26	155	370
	5	"	0.53	Al 0.41	20	161	450
	6	"	0.50	Mn 0.55	21	135	470
	7	"	0.51	Ag 0.10	31	124	310
	8	"	0.47	Zn 2.31	30	127	340
	9	"	0.52	Sn 1.28	21	172	420
	10	"	0.50	Ti 0.86	59	175	330
	11	"	0.53	Zr 0.21	38	145	340
	12	"	0.51	Cr 0.68	40	169	300
	13	"	0.52	Fe 1.49	42	158	320
	14	"	0.49	Co 1.73	51	177	300
	15	"	0.50	Ni 2.25	55	183	280
	16	"	0.54	Ni 2.23 Zn 1.14	53	185	270
	17	"	0.70	Ni 3.2 Mg 0.01 Zn 0.2 Mn 0.03	45	210	245
比 較 合 金	18	"	0.06	—	80	102	590
	19	"	1.13	—	18	133	560
	20	タフピッチ銅(C1100)			100	98	780
	21	Ag入り銅(Cu-0.03Ag)			99	105	630

【0011】次に本発明に係る銅合金及び比較合金の回転通電摩耗試験を行った。この試験は図1に示す回転通電摩耗試験機を用いて行った。図に示すごとく本発明合金NO. 1~17及び比較合金NO. 18~21を、寸法40mmφ×4mm tの円板に加工し4等分した試験片1を絶縁体11間に配設して4極の回転体とし、この回転体の両極面にはカーボンブラシ2、2の一端を接触させ他端に板バネ3、3の下部を連結した。この板バネ3、3の上端部にはそれぞれ加圧治具9、9の一端を連結し、その他端にはオモリ4をそれぞれ接続した。なお、10は試験片1に連結された通電用リード線、5はカーボンブラシ2、2に連結される電線、6は直流電源、7は電流計、8は加圧治具の支柱である。

【0012】上記の装置において、試験片1とカーボンブラシ2との接触圧力をオモリ4を用いて調整し、435g/cm²とした。この状態で試験片1に電流密度0.2A/mm²で通電し、周速度6.3m/sec（回転数：3000rpm）でモータを回転させ通電回転摩耗試験を行なった。雰囲気は15℃の大気中とし、400時間後の試験片1の摩耗量を調査した。その結果を表1にあわせて示す。

【0013】本発明合金はSiを0.1~1.0wt%の範囲で含有するとともに、良好な導電率と硬さを有しており、耐放電摩耗性が優れている。一方、比較合金No. 18はSi含有量が少なく、耐放電摩耗性向上効果が小さい。さらにNo. 19はSiが多すぎるため、導

電率が低下し摩耗量が大きくなっている。No. 20、21はSiを含んでおらず、優れた導電率を有するものの、摩耗量が大きい。

【0014】

【発明の効果】以上説明したように、本発明の銅合金は、従来品に比較して導電率は低いものの耐放電摩耗性に優れており、例えばモーターコンミュテータ及び各種

接点部品の寿命向上に寄与すること大である。

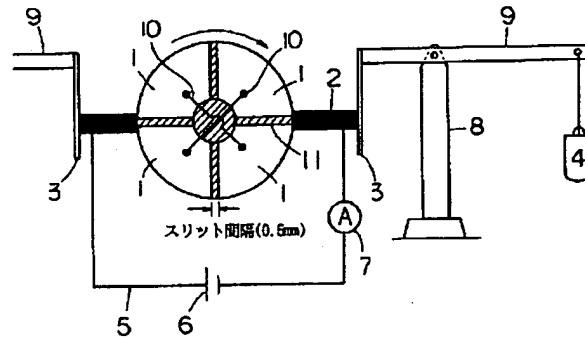
【図面の簡単な説明】

【図1】耐放電摩耗性を試験する回転通電摩耗試験機の側面図である。

【符号の説明】

- 1 試験片
- 2 カーボンブラシ

【図1】



(19) Japanese Patent Office (JP)

(12) Official Gazette for Unexamined Patents (A)

(11) Kokai Patent No. Hei 9(1997)-263,864

(43) Kokai Date: October 7, 1997

*SPCS < 802
for New claims*

Technical labels

(51) <u>Int. Cl.⁶:</u>	<u>Identification No.:</u>	<u>Internal File No.:</u>	<u>FI:</u>
C22C 9/10			C22C 9/10
H01R 39/04			H01R 39/04
39/20			39/20
// H02K 13/00			H02K 13/00

Request for Examination: Not Requested Number of Claims: 2 FD

(Total of 4 Pages)

(54) COPPER ALLOY

WITH EXCELLENT DISCHARGE ABRASION RESISTANCE

(21) Application No. Hei 8(1996)-97,785

(22) Filing Date: March 26, 1996

(71) Applicant: 000001199
Kobe Steel, Ltd.
3-18, Kyohama-cho 1 chome, Chuo-ku, Kobe-shi, Hyogo-ken

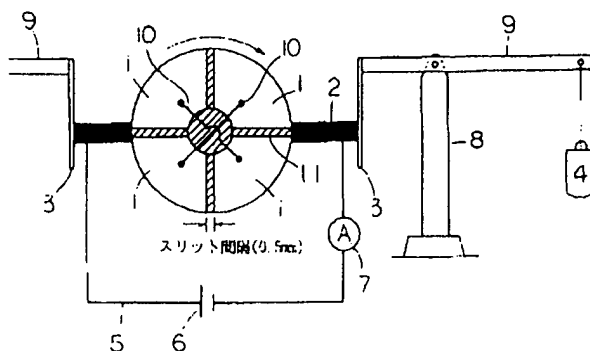
(72) Inventor: Akihiro Shokura
Kobe Steel, Ltd., Nagafu Factory, 14-1, Nagafuko-cho,
Shitaseki-shi, Yamaguchi-ken

(71) Agent: Kaoru Komoto, Patent Attorney

(57) [Abstract]

[Object] To obtain copper alloys with excellent discharge abrasion resistance.

[Means] A copper alloy containing 0.01 - 1.0 wt% Si and further containing a total of 0.01 - 6.0 wt% of one or more of the following: 0.01 - 1.0 wt% Mg, 0.01 - 1.0 wt% Al, 0.01 - 1.0 wt% Ti, 0.01 - 1.0 wt% Cr, 0.01 - 1.0 wt% Mn, 0.01 - 3.0 wt% Fe, 0.01 - 3.0 wt% Co, 0.01 - 4.0 wt% Ni, 0.01 - 5.0 wt% Zn, 0.01 - 1.0 wt% Zr, 0.01 - 1.0 wt% Ag, and 0.01 - 2.0 wt% Sn as needed, with the remainder being copper and unavoidable impurities.



In fig: Slit spacing (0.5 mm)

[Scope of Patent Claim]

[Claim 1]

A copper alloy with excellent discharge abrasion resistance, characterized in that it contains 0.1 – 1.0 wt% Si, with the remainder being copper and unavoidable impurities.

[Claim 2]

A copper alloy containing 0.01 -1.0 wt% Si and further containing a total of 0.01 - 6.0 wt% of one or more of the following: 0.01 - 1.0 wt% Mg, 0.01 – 1.0 wt% Al, 0.01 – 1.0 wt% Ti, 0.01 – 1.5 wt% Cr, 0.01 – 1.0 wt% Mn, 0.01 – 3.0 wt% Fe, 0.01 – 3.0 wt% Co, 0.01 – 4.0 wt% Ni, 0.01 – 5.0 wt% Zn, 0.01 – 1.0 wt% Zr, 0.01 – 1.0 wt% Ag, and 0.01 – 2.0 wt% Sn as needed, with the remainder being copper and unavoidable impurities.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention]

The present invention pertains to copper alloys used in parts that are exposed to discharge abrasion, such as motor switches and various types of contacts, etc.

[0002]

[Prior Art]

Oxygen-free copper, tough-pitch copper, phosphorus-deoxidized copper, silver-added copper, etc., with high conductivity have been used in the past as

the materials for motor switches and contacts. This is because materials with a high conductivity generate little Joule heat at the contact and also have a strong heat-releasing effect and therefore, an increase in the temperature of the contacts can be prevented and the amount of discharge is low. However, there is a demand for switches and various contact parts used in automobiles, etc., with even longer life because of the need for improved reliability. Therefore, the development of a copper alloy with excellent discharge abrasion resistance to replace the above-mentioned pure copper materials has become necessary.

[0003]

[Problems to be solved by the invention]

The present invention is presented in light of the above-mentioned problems of the prior art, its object being to present copper alloys with excellent discharge abrasion resistance.

[0004]

[Means for solving problems]

The copper alloys with excellent discharge abrasion resistance of the present invention are characterized in that they contain 0.1 – 1.0 wt% Si, with the remainder being copper and unavoidable impurities. They further contain a total of 0.01 - 6.0 wt% of one or more of the following: 0.01 - 1.0 wt% Mg, 0.01 – 1.0 wt% Al, 0.01 – 1.0 wt% Ti, 0.01 – 1.5 wt% Cr, 0.01 – 1.0 wt% Mn, 0.01 – 3.0 wt% Fe, 0.01 – 3.0 wt% Co, 0.01 – 4.0 wt% Ni, 0.01 – 5.0 wt% Zn, 0.01 – 1.0 wt% Zr, 0.01 – 1.0 wt% Ag, and 0.01 – 2.0 wt% Sn as needed.

[0005]

The reasons for adding each component of the copper alloys pertaining to the present invention and the reasons for restricting their composition are explained below:

Si: 0.1 = 1.0 wt%

Si is an essential component of the alloys of the present invention. The oxide of Si (SiO_2) produces little free energy and has a high melting point ($1,720^\circ\text{C}$). Therefore, it is stable at high temperatures. It also has a high electrical resistance at high temperatures ($3 \times 10^2 \Omega \cdot \text{m}$ at $1,200^\circ\text{C}$). On the other hand, it appears that discharge occurs due to interaction between electrons emitted from the material surface and metal vapor during the time when the contacts, which have generated heat with the conduction of electricity, are turned OFF. Alloys containing Si are responsible for rapidly extinguishing discharge during this time because an oxide film is readily produced on the material surface and this oxide surface is stable and has high electrical resistance at high temperatures. The inventors successfully completed the present invention upon discovering that in addition to conductivity, this extinguishing effect is important in parts that undergo discharge abrasion, such as switches and various types of contact parts, etc. This effect will be insignificant if the Si content is less than 0.1 wt%, while if content exceeds 1.0 wt%, this effect will be saturated and there will be a reduction in conductivity and deterioration of hot workability. Consequently, the Si content is set at 0.1 – 1.0 wt%. The particularly preferred range is 0.2 – 0.8 wt%.

[0006]

Mg, Al, Mn, Ag: 0.01 – 1.0 wt% each

Zn: 0.01 – 5.0 wt%

Sn: 0.01 – 2.0 wt%

These elements are added for the purpose of further strengthening the solid solution of the Cu-Si alloy. The most important property of contact materials is discharge abrasion resistance, but the amount of mechanical wear as a result of repeatedly turning the contacts ON and OFF should also be small. Consequently, these elements are added as needed in order to improve abrasion resistance. This effect is minimal when the content of each of these is less than 0.01 wt%. Moreover, if the content of each of these elements exceeds its upper limit, the effect will be saturated, and with the exception of Ag, there will be a marked reduction in conductivity. Furthermore, Ag is expensive and the above-mentioned upper limit was set taking into consideration economic constraints as well. The preferred contents of each are 0.01 – 0.6 wt% Mg, Al, Mn and Ag each, 0.03 – 3.5 wt% Zn, and 0.1 – 1.5 wt% Sn.

[0007]

Ti, Zr: 0.01 – 1.0 wt% each

Cr: 0.01 – 1.5 wt%

Fe, Co: 0.01 – 3.0 wt% each

Ni: 0.01 – 4.0 wt%

These elements form a compound with Si that precipitates and hardens when they are added to Cu-Si alloys. As in the case of the above-mentioned elements, they are added as needed for the purpose of improving abrasion

resistance. This effect will be minimal if the content of each of these is less than 0.01 wt%, while if the content of each of the elements exceeds the upper limit, this effect will be saturated and there will be a marked reduction in conductivity. Consequently, the above-mentioned upper and lower limits were established. The preferred contents are: 0.05 – 1.0 wt% Ti, 0.01 – 0.3 wt% Zr, 0.05 – 1.0 wt% Cr, 0.1 – 2.5 wt% Fe and Co each, and 0.3 – 4 wt% Ni.

[0008]

Furthermore, two or more of the above-mentioned components can be combined and added. If the total amount is less than 0.01 wt%, the effect of improving strength will be insignificant, while if the total amount exceeds 6.0 wt%, there will be a marked reduction in conductivity. Consequently, the total amount when they are added in combination with one another was set at 0.01 – 6.0 wt%. 0.5 – 3% is preferred. The combination of Ti (or Zr, Cr, Fe, Co, Ni) and Mg (or Al, Mn, Ag, Zn, Sn) is given as a preferred combination of auxiliary components.

[0009]

[Examples]

Examples of the present invention will be described below in comparison with comparative examples. Copper alloys with the compositions shown in Table 1 were melted and cast in air and covered with charcoal using a kryptol furnace to obtain ingots that were 50 mm thick, 75 mm wide and 180 mm long. After machining the front and back of these ingots, they were hot-rolled to a thickness of 15 mm at a temperature of 950°C. Then, after removing the oxidation scale with a grinder, they were cold-rolled and annealed for 1 hour at a temperature of

500°C. They were brought to a thickness of 4.0 mm by final cold rolling. The Vickers hardness and the conductivity of the copper alloys of the present invention and comparative alloys are shown in Table 1.

[0010]

[Table 1]

		Chemical components			Conductivity (% IACS)	Vickers hardness (Hv)	Amount of wear (mg)
		Cu	Si	Auxiliary component			
Alloys of the present invention	1	Remainder	0.19	--	57	106	430
	2	"	0.52	--	32	117	360
	3	"	0.91	--	22	129	460
	4	"	0.48	Mg 0.34	26	155	370
	5	"	0.53	Al 0.41	20	161	450
	6	"	0.50	Mn 0.55	21	135	470
	7	"	0.51	Ag 0.10	31	124	310
	8	"	0.47	Zn 2.31	30	127	340
	9	"	0.52	Sn 1.28	21	172	420
	10	"	0.50	Ti 0.86	59	175	330
	11	"	0.53	Zr 0.21	38	145	340
	12	"	0.51	Cr 0.68	40	169	300
	13	"	0.52	Fe 1.49	42	158	320
	14	"	0.49	Co 1.73	51	177	300
	15	"	0.50	Ni 2.25	55	183	280
	16	"	0.54	Ni 2.23 Zn 1.14	53	185	270
	17	"	0.70	Ni 3.2 Mg 0.01 Zn 0.2 Mn 0.03	45	210	245
Comparative alloys	18	"	0.06	--	80	102	590
	19	"	1.13	--	18	133	560
	20	Tough pitch copper (C1100)			100	98	780
	21	Ag-added copper (Cu -0.03 Ag)			99	105	630

[0011]

Next, abrasion tests conducted by rotating specimens while conducting electricity were performed on the copper alloys of the present invention as well as comparative alloys. The tests were performed using the test device shown in

Figure 1 for rotating while conducting electricity. As shown in the figure, Alloy Nos. 1 – 17 of the present invention and Comparative Alloy Nos. 18 – 21 were worked into discs with dimensions of 40 mm ϕ x 4 mm t and divided into 4 equal pieces to obtain test piece 1. These [equal pieces] were placed between insulators 11 to obtain a rotating object with 4 poles. One end of carbon brushes 2 and 2 was brought into contact with the bipolar surfaces of this rotating object and the bottom ends of flat springs 3 and 3 were joined with the other end. One end of pressing tools 9 and 9 were joined with the tops of these flat springs 3 and 3 and weights 4 were connected to the other ends. Furthermore, 10 is a lead wire for conducting electricity that is joined to test piece 1, 5 is a wire that is joined to carbon brushes 2 and 2, 6 is a direct-current power source, 7 is an ammeter, and 8 is the support for the pressing tools.

[0012]

By means of the above-mentioned device, the contact pressure between test piece 1 and carbon brush 2 was adjusted to 435 g/cm² using weight 4. Under these conditions, electricity was conducted to test piece 1 at a current density of 0.2 A/mm² and the motor was turned at a peripheral speed of 6.3 m/sec (rotational speed: 3,000 rpm) to perform abrasion tests by rotating while conducting electricity. The ambient atmosphere was air at 15°C and the amount of wear of test piece 1 after 400 hours was determined. The results are also shown in Table 1.

[0013]

The alloys of the present invention contain 0.1 – 1.0 wt% Si and have good conductivity and hardness. [Therefore] discharge abrasion resistance is excellent. On the other hand, Comparative Example Alloy No. 18 has a low Si content and therefore, the effect of improving discharge abrasion resistance is insignificant. Furthermore, No. 19 has too high an Si content and therefore, conductivity is reduced and the amount of wear is increased. No. 20 and 21 do not contain Si and therefore, although they have excellent conductivity, the amount of wear is high.

[0014]

[Results of the invention]

As previously explained, the copper alloys of the present invention have low conductivity but excellent discharge abrasion resistance when compared to conventional products. They therefore have a strong effect in terms of improving the life of motor switches and various types of contact parts.

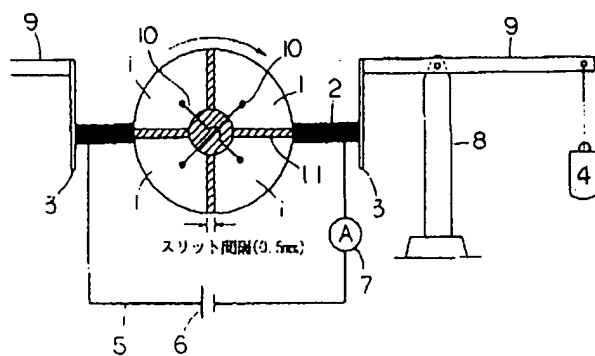
[Brief Description of the Drawings]

[Figure 1] is a side view of the device for testing wear as a result of rotating while conducting electricity in order to investigate discharge abrasion resistance.

[Definition of symbols]

1. Test piece
2. Carbon brush

[Figure 1]



In fig.: Slit spacing (0.5 mm)